PATENT ABSTRACTS OF JAPAN

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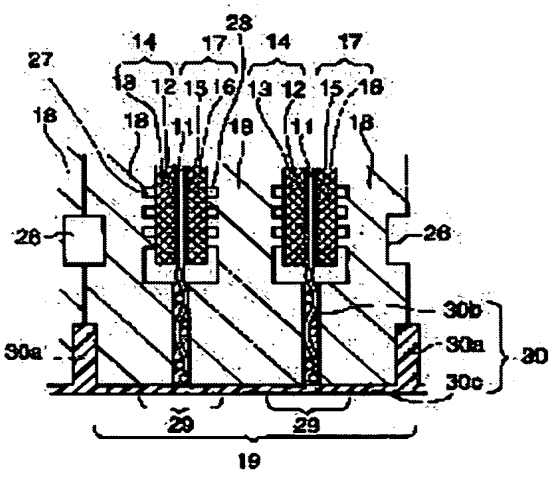
(54) STACK STRUCTURE OF FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a stack structure of a fuel cell wherein pressure parts are eliminated or the pressure parts can be downsized even in case the pressure parts are installed.

SOLUTION: (1) This is the stack structure 23 of the fuel cell 10 wherein a cell laminated body is constituted by plurally laminating modules 19 composed of cells 29 of one layer or more and the cell laminated body is tightened in the cell laminating direction of the cell laminated body, and wherein this is adhered by an adhesive 30 between the modules 19. (2) The cells 29 have plural sub-cells 31 in the same plane. (3) A plate 34 is installed at the side face of the cell laminated body, and at least one part 30c of the adhesive 30 is filled between the plate 34 and the side face of the cell laminated body.



LEGAL STATUS

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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] Stack structure of the fuel cell which is the stack structure of the fuel cell which carried out two or more laminatings of the module which consists of a cel of one or more layers, constituted the cel layered product, and bound tight and constituted this cel layered product in the direction of a cel laminating, and pasted up the inter module with adhesives.
[Claim 2] Said cel is the stack structure of the fuel cell according to claim 1 which has two or more subcels in the same side.
[Claim 3] Stack structure of the fuel cell according to claim 1 which prepared the plate in the side face of said cel layered product, and was filled up with said some of adhesives [at least] between this plate and the side face of said cel layered product.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the stack structure of a solid-state polyelectrolyte mold fuel cell about the stack structure of a fuel cell.
[0002]
[Description of the Prior Art] The single cel of a solid-state polyelectrolyte mold fuel cell consists of a film-electrode assembly (MEA:Membrane-Electrode Assembly) and a separator. a film-electrode assembly (MEA:Membrane-Electrode Assembly) consists of an electrode (a cathode, air pole) which consists of the catalyst bed and diffusion layer of the electrode (an anode, fuel electrode) which consists of the catalyst bed and diffusion layer which have been arranged at the whole surface of the electrolyte membrane which consists of ion exchange membrane, and this electrolyte membrane, and an electrolyte membrane which were alike on the other hand and have been arranged. A separator forms the fluid channel for supplying fuel gas (anode gas, hydrogen) and oxidation gas (cathode gas, oxygen, usually air) to an anode and a cathode. A fuel cell stack carries out the laminating of the cel of one or more layers, considers as a module, carries out two or more laminatings of the module, constitutes a cel layered product, it arranges a terminal, an insulator, and an end plate to the direction both ends of a cel laminating of a cel layered product, binds a cel layered product tight in the direction of a cel laminating, and consists of what was fixed in the conclusion member (for example, tension plate) prolonged in the direction of a cel laminating on the outside of a cel layered product. In a solid-state polyelectrolyte mold fuel cell, hydrogen is used as a hydrogen ion and an electron by the anode side, a hydrogen ion moves the inside of an electrolyte membrane to a cathode side, and water is generated by the cathode side from oxygen, a hydrogen ion, and an electron (the electron of the cel of the end of a cel layered product with which the electron generated with the anode of the next MEA lets a separator pass comes to the cel of the other end of a cel layered product through an external circuit).
anode side: -- H2 ->2H++2e-cathode side: -- in order to cool the heat which comes out at the water generation reaction in the 2H++2e-+(1/2) O2 ->H2 O Joule's heat and a cathode -- between separators -- every cel -- or the passage where a cooling medium (usually cooling water) flows is formed for two or more cels of every, and the fuel cell is cooled. In order to perform the above-mentioned electrochemical reaction normally, the electric contact to a separator and an electrode is held, and from a separator and inter-electrode, as for a cel layered product (it is also a module layered product), fluids, such as fuel gas, oxidation gas, and a refrigerant, must be bound tight in the direction of a cel laminating so that it may not leak from between separators, and this bolting must be held. Bolting of the conventional cel layered product and bolting maintenance are performed by pushing a cel layered product through a spring so that the stack which carried out the laminating of the cel may be fixed in the direction of a cel laminating with a clamping-bolt nut and a bolting load may be stabilized as indicated by JP,2000-208163,A.
[0003]
[Problem(s) to be Solved by the Invention] However, in bolting of the cel layered product of the conventional approach, and bolting maintenance, the pressurization components containing a spring are required, and in order to obtain required electric contact and a required seal, pressurization components are large-sized and become weight size. Moreover, if it is going to connect to a serial or

juxtaposition the substack which allotted the subcel of plurality (for example, n) in the same side of a cel, and connected and constituted it in the direction of a laminating in order to shorten the cel laminating lay length of a cel layered product Cel area doubles [two or more (for example, n)], in proportion to it, pressurization components are large-sized, and become weight size, and a shortened part of the part cel layered product which pressurization components enlarged is offset, and it is no longer obtained, so that the die-length compaction effectiveness of a cel layered product expected. Even if the purpose of this invention loses pressurization components or prepares pressurization components, it is to offer the stack structure of a fuel cell which can miniaturize pressurization components.

[0004]

[Means for Solving the Problem] This invention which attains the above-mentioned purpose is as follows.

(1) Stack structure of the fuel cell which is the stack structure of the fuel cell which carried out two or more laminatings of the module which consists of a cel of one or more layers, constituted the cel layered product, and bound tight and constituted this cel layered product in the direction of a cel laminating, and pasted up the inter module with adhesives.

(2) Said cel is the stack structure of the fuel cell given in (1) which has two or more subcels in the same side.

(3) Stack structure of the fuel cell given in (1) which prepared the plate in the side face of said cel layered product, and was filled up with said some of adhesives [at least] between this plate and the side face of said cel layered product.

[0005] In the stack structure of the fuel cell of the above (1), since the inter module was pasted up with adhesives, while welding pressure can be held with adhesives, and being able to miniaturize even if the pressurization components which were need conventionally become unnecessary or it prepares, consequently being able to miniaturize a fuel cell stack (shortened in the direction of a cel laminating), weight reduction and cost reduction can be measured. In the stack structure of the fuel cell of the above (2), although cel area increases even if a cel has two or more subcels in the same field, the advantage of shortening of the stack by whether there are any pressurization components and not causing enlargement of pressurization components and preparing two or more subcels in the same field, since it can miniaturize is maintainable as it is. Since the plate was prepared in the side face of a cel layered product and some adhesives [at least] were filled up with the stack structure of the fuel cell of the above (3) between the plate and the side face of a cel layered product, while welding pressure can be held on adhesives and a plate, and being able to miniaturize even if the pressurization components which were need conventionally become unnecessary or it prepares, consequently being able to miniaturize a fuel cell stack (shortened in the direction of a cel laminating), weight reduction and cost reduction can be measured. Moreover, also in the time of a car collision etc., a cel layered product can be protected with a plate.

[0006]

[Embodiment of the Invention] Below, the stack structure of the fuel cell of this invention is explained with reference to drawing 1 - drawing 8 (for drawing 1 - drawing 4 , about this invention, drawing 5 - drawing 8 are an example of a comparison). The fuel cell 10 with which the stack structure of this invention is applied is a solid-state polyelectrolyte mold fuel cell. The fuel cell 10 of this invention is carried in a fuel cell powered vehicle. However, it may be used in addition to an automobile.

[0007] The single cel 29 of the solid-state polyelectrolyte mold fuel cell 10 consists of a film-electrode assembly (MEA:Membrane-Electrode Assembly) and a separator 18, as shown in drawing 1 - drawing 4 . MEA consists of an electrode 17 (a cathode, air pole) which consists of the catalyst bed 15 and diffusion layer 16 of the electrolyte membrane 11 which consists of ion exchange membrane, and the electrode 14 (an anode, fuel electrode) which consists of the catalyst bed 12 and diffusion layer 13 which have been arranged at the whole surface of this electrolyte membrane 11 and an electrolyte membrane 11 which were alike on the other hand and have been arranged.

[0008] A separator 18 forms the refrigerant passage 26 where the fluid channel 28 for supplying oxidation gas (oxygen, usually air) to the fluid channel 27 and electrode 17 for supplying fuel gas (hydrogen) to an anode 14 and the refrigerant for fuel cell cooling (cooling water) flow. The

refrigerant passage 26 is formed for every cel and two or more cels of every. For example, one refrigerant passage 26 is formed every two cels. A separator 18 forms the path of the electrical and electric equipment with which an electron flows from the anode of an adjacent cel to a cathode while separating mutually any of fuel gas, oxidation gas and fuel gas, cooling water and oxidation gas, and cooling water ** they are. A separator 18 consists of either of the thing **s which formed the refrigerant passage 26 and gas passagewaies 27 and 28 in the thing which formed the refrigerant passage 26 and gas passagewaies 27 and 28 in the carbon plate, the thing which piled up two or more metal plates with the irregularity which forms passage 26, 27, and 28, or the resin plate made from electric conduction (for example, resin plate which mixed the electric conduction material particle and gave conductivity). The example of illustration shows the case where a separator 18 consists of a carbon plate.

[0009] Between modules 19 is pasted up by adhesives 30a, and the stack 23 of a fuel cell is constituted while carrying out two or more laminatings of the module 19 (fixed by adhesives 30b between cels between the separators 18 which sandwiched the electrolyte membrane 11 when it constitutes one module from two or more cels) which consists of a cel 29 of one or more (drawing 2 two-layer) layers, constituting a cel layered product and binding this cel layered product tight in the direction of a cel laminating. Between separators, adhesives 30b between cels holds an electrode, and needs insulation. Adhesives 30a of an inter module carries out the seal of the inter module, and although a thing with conductivity may be used, since distinguishing by different color with with that insulating is serious, that insulating may be used. Spreading formation of the adhesives 30 may be carried out on the side face of a cel layered product. That insulating is used for adhesives 30c which carried out spreading formation on the side face of a cel layered product in order to secure the insulation between cels. The direction bolting of a cel laminating of a cel layered product is required because of the seal of fuel gas, oxidation gas, and a refrigerant in order to acquire the electric contact to a separator and an electrode. In the direction both ends of a cel laminating of a cel layered product, an end plate 22 is arranged a terminal 20, an insulator 21, and if needed.

[0010] A binder 30 (30a, 30b) consists of an ingredient which uses resin as a principal component, and is dried and solidified. The binder 30 may contain the ceramic bead (ceramic corpuscle), when used for a part with required at the time of cel layered product bolting preventing contact between separators or between a separator and a metal plate. Binder 30b is applied to a module opposed face, when carrying out the laminating of the cel and considering as a cel layered product, and binder 30c is applied to a cel layered product side face behind a cel laminating. Then, it dries, and it is solidified and Binders 30b and 30c turn into a cel bolting load attachment component. Maintenance of the bolting load between the cels 29 of the direction of a cel laminating and between modules 19 is performed by adhesives 30 (30a, 30b, 30c) as shown in drawing 2 . Moreover, as shown in drawing 4 , if needed, a plate 34 may be arranged on the outside of a cel layered product, it may be made to fill up with and carry out desiccation solidification of between plate 34 side face and cel layered products with adhesives 30 (30c), and the bolting load of an inter module may be held on it with both a plate 34 and the adhesives 30 (30a, 30b, 30c). When forming a plate 34, the both ends of a plate 34 may be fixed to an end plate 22 with the bolt 25 prolonged in the direction of a cel laminating, and the rectangular direction.

[0011] The cel 29 may have the subcel 31 of plurality (although four cases are shown by a diagram, the number is not restricted to 4) each other electrically insulated in the same field, as shown in drawing 3 . Although the subcel 31 shares an electrolyte membrane 11 in the same side, the electrodes 14 and 17 of each other are electrically insulated by subcel independence. When the laminating of the cel 29 is carried out, it connects with a serial in the direction of a cel laminating, and the subcel 31 constitutes a substack. Substacks are the direction edges of a cel laminating of a cel layered product, and they are mutually connected to a serial or juxtaposition electrically. When a cel 29 has two or more subcels 31, the direction die length of a cel laminating of a cel layered product is shortened.

[0012] Drawing 5 - drawing 8 show the example of a comparison (it does not contain in this invention). Drawing 5 and drawing 6 carry out the laminating of the cel with the same cel area as the subcel 31 of this invention, allot a pressure plate 32 to the direction end of a cel laminating of a cel layered product, allot a disk spring 33 between a pressure plate 32 and an end plate 22, and show the

example which gave the conclusion load to the cel layered product.
[0013] Although the thing of drawing 7 and drawing 8 is similarly an example of a comparison, it carries out the laminating of the cel which has four subcels (each subcel area is the same as the cel area of drawing 6) in the same field, and sets cel layered product die length to one fourth compared with the thing of drawing 5 . Since cel area increased 4 times of the thing of drawing 6 , the load given in the direction of a cel laminating will be 4 times the thing of drawing 5 and drawing 6 . Therefore, a pressure plate 32, an end plate 22, and a disk spring 33 are enlarged in the direction of a cel laminating, and it and the rectangular direction. Consequently, even if cel layered product die length is set to one fourth of the things of drawing 5 , the cel layered product compaction effectiveness by the stack die length containing a cel layered product and pressurization components having become larger than it by not being set to one fourth of the things of drawing 5 , and having formed it into the subcel, when pressurization components were enlarged fades.
[0014] Below, an operation of the stack structure of the fuel cell of this invention is explained. In the stack structure of the fuel cell of this invention, since between modules 19 was pasted up with adhesives, welding pressure can be held with adhesives, and as the pressurization components (the disk spring 33 of drawing 5 - drawing 8 , pressure plate 32 grade) which were need conventionally show drawing 1 , even if it becomes unnecessary or prepares pressurization components, such as a disk spring, it can miniaturize in the direction of a cel laminating. Consequently, while being able to miniaturize a fuel cell stack (shortened in the direction of a cel laminating), weight reduction and cost reduction can be measured.
[0015] Moreover, although cel 29 area increases like the stack structure of the fuel cell of drawing 3 even if a cel 29 has two or more subcels 31 in the same field, the advantage of shortening of the stack length by whether there are any pressurization components and not causing enlargement of pressurization components and preparing two or more subcels in the same field, since it can miniaturize is maintainable as it is. In more detail, in the stack structure of the fuel cell of drawing 3 of this invention, when the area of each subcel 31 is equal to the cel area of the thing of drawing 6 , the cel laminating lay length of the cel layered product of the cel 29 with the subcel 31 of drawing 3 is set to 1 for the subcel number of the direction die length of a cel laminating of the cel layered product of drawing 5 . In the example of drawing 3 , since the subcel number is 4, the die length of the cel layered product which carried out the laminating of the cel 29 of drawing 3 is set to one fourth of the die length of the usual cel layered product of drawing 5 . And in this invention, since the bolting load of the direction of a cel laminating is held with adhesives 30, even if it is not necessary to prepare a disk spring in the end of a cel layered product like drawing 7 or and prepares, compared with pressurization components including the disk spring 33 of the thing of drawing 7 , and a pressure plate 32, it is miniaturized in the direction of a cel laminating.
[0016] Moreover, in the stack structure of the fuel cell of drawing 4 , a plate 34 is formed in the side face of a cel layered product, and even if the pressurization components of adhesives 30 which welding pressure could be held on adhesives 30c and a plate 34, and were need conventionally since it was filled up with 30c between the plate 34 and the side face of a cel layered product in part at least become unnecessary or it prepares, it can miniaturize. Consequently, while being able to miniaturize a fuel cell stack (shortened in the direction of a cel laminating), weight reduction and cost reduction can be measured. Moreover, although a plate 34 is structure material similar to the tension plate 24 (drawing 5 , drawing 7) which is prolonged between the conventional both-ends end plates, and holds a stack conclusion load, since the plate 34 of this invention receives a stack bolting load with both a plate 34 and the adhesives 30, compared with the former which had received the conclusion force, the thickness of a plate 34 can do it more thinly than the thickness of a tension plate 24 only with a tension plate 24. Therefore, even if it is the case where a plate 34 is formed, weight mitigation is aimed at compared with the former which had formed the tension plate 24. moreover, the plate 34 -- the time of car loading -- the before [a car cross direction] side of a stack 23 -- **** -- also in the time of a car collision etc., a cel layered product can be protected with a plate 34 by things. Therefore, a plate 34 has also achieved the stack protective effect at the time of a car collision while playing the role which receives the conclusion force.
[0017]
[Effect of the Invention] Since the inter module was pasted up with adhesives, while according to the

stack structure of the fuel cell of claim 1 welding pressure can be held with adhesives, and being able to miniaturize even if the pressurization components which were need conventionally become unnecessary or it prepares, consequently being able to miniaturize a fuel cell stack (shortened in the direction of a cel laminating), weight reduction and cost reduction can be measured. Although according to the stack structure of the fuel cell of claim 2 cel area increases even if a cel has two or more subcels in the same field, the advantage of shortening of the stack by whether there are any pressurization components and not causing enlargement of pressurization components and preparing two or more subcels in the same field, since it can miniaturize is maintainable as it is. Since according to the stack structure of the fuel cell of claim 3 the plate was prepared in the side face of a cel layered product and it was filled up with some adhesives [at least] between the plate and the side face of a cel layered product, while welding pressure can be held on adhesives and a plate, and being able to miniaturize even if the pressurization components which were need conventionally become unnecessary or it prepares, consequently being able to miniaturize a fuel cell stack (shortened in the direction of a cel laminating), weight reduction and cost reduction can be measured. Moreover, also in the time of a car collision etc., a cel layered product can be protected with a plate.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the side elevation of the fuel cell with which the stack structure of the fuel cell of this invention was applied.
[Drawing 2] They are some expanded sectional views of the fuel cell of drawing 1 .
[Drawing 3] In the stack structure of the fuel cell of this invention, it is the front view of a cel in case a cel has two or more subcels in the same side.
[Drawing 4] In the stack structure of the fuel cell of this invention, they are some [at the time of preparing a plate in a cel layered product side face and being filled up with resin also between a plate and a cel layered product side face] expanded sectional views of a fuel cell.
[Drawing 5] It is the side elevation of the fuel cell of the example 1 (a cel does not have two or more subcels) of a comparison.
[Drawing 6] It is the front view of the cel of the fuel cell of drawing 5 .
[Drawing 7] It is the side elevation of the fuel cell of the example 2 (a cel has two or more subcels) of a comparison.
[Drawing 8] It is the front view of the cel of the fuel cell of drawing 7 .
[Description of Notations]
10 Solid-state Polyelectrolyte Mold Fuel Cell
11 Electrolyte Membrane
12 Catalyst Bed
13 Diffusion Layer
14 Electrode (Anode, Fuel Electrode)
15 Catalyst Bed
16 Diffusion Layer
17 Electrode (Cathode, Air Pole)
18 Separator
19 Module
20 Terminal
21 Insulator
22 End Plate
23 Stack
24 Tension Plate
25 Bolt
26 Refrigerant Passage
27 Fuel Gas Passage
28 Oxidation Gas Passageway
29 Cel
30 Adhesives
30a Inter module adhesives
30b Cel indirect adhesive
30c A plate and a cel layered product side-face indirect adhesive
31 SubCel
32 Pressure Plate

33 Disk Spring
34 Plate

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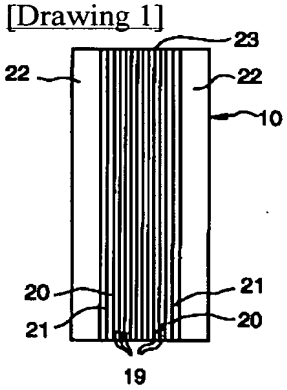
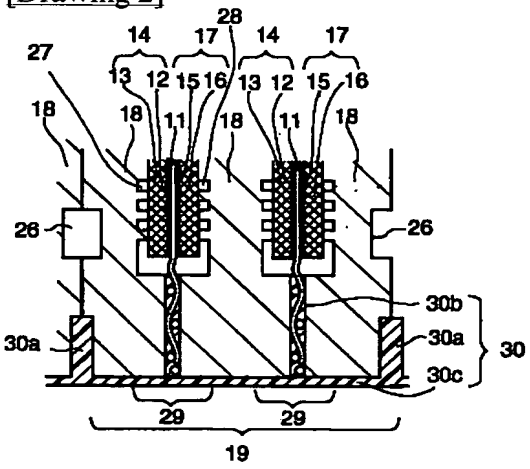
DRAWINGS

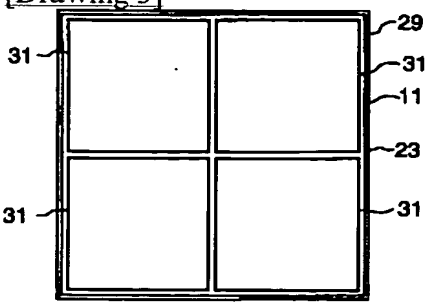
[Drawing 1]



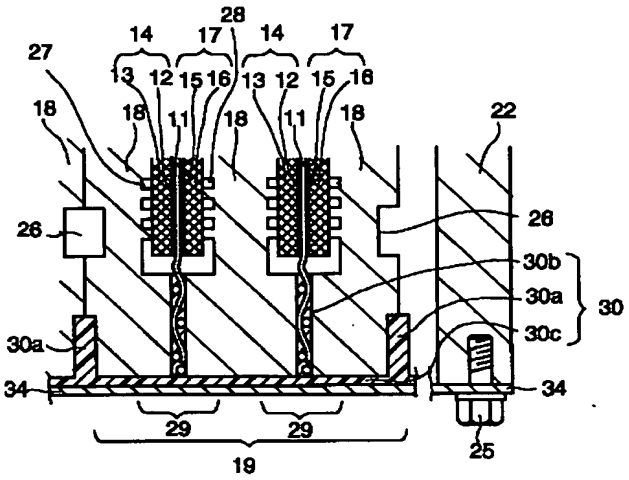
[Drawing 2]



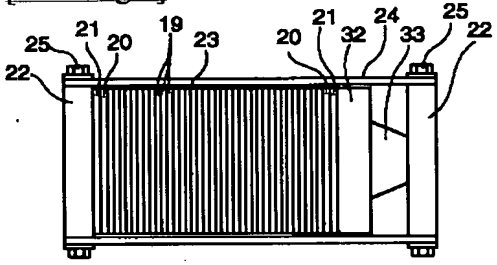
[Drawing 3]



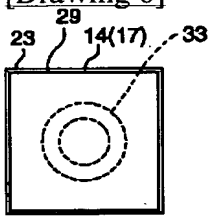
[Drawing 4]



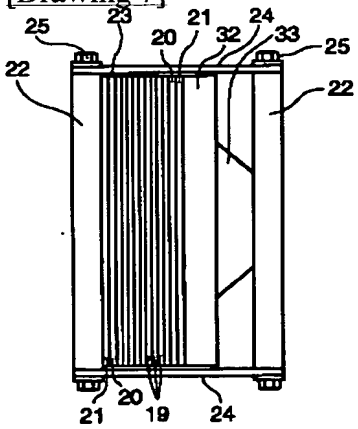
[Drawing 5]



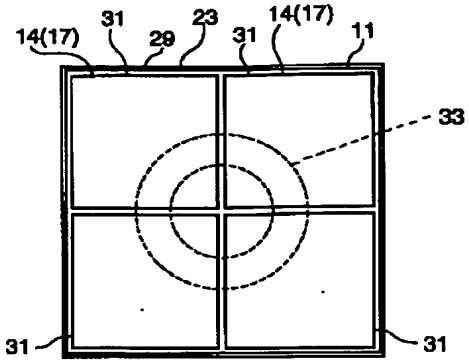
[Drawing 6]



[Drawing 7]



[Drawing 8]



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Ｈ０１Ｍ　8/24		Ｈ０１Ｍ　8/24	Ｅ	５Ｈ０２６
8/10		8/10		

審査請求　未請求　請求項の数３　ＯＬ　（全 ６ 頁）

(21)出願番号　特願2001－273983(P2001－273983)

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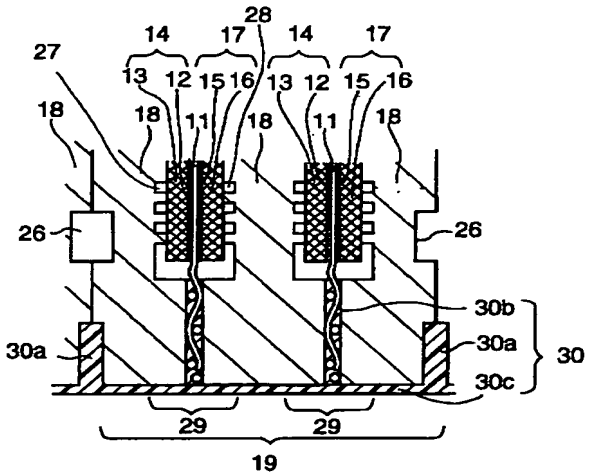
Ｆターム(参考)　5H026 AA06 CC03 CX04 CX07 CX10 EE18

(54)【発明の名称】　燃料電池のスタック構造

(57)【要約】
【課題】　加圧部品を無くすか、または加圧部品を設けても加圧部品を小型化できる、燃料電池のスタック構造の提供。
【解決手段】　（１）１層以上のセル２９からなるモジュール１９を複数積層してセル積層体を構成し該セル積層体をセル積層方向に締め付けて構成した燃料電池１０のスタック２３構造であって、モジュール１９間を接着剤３０により接着した燃料電池のスタック構造。（２）セル２９は同一面内に複数のサブセル３１を有している。（３）セル積層体の側面にプレート３４を設け、接着剤３０の少なくとも一部３０ｃを該プレート３４とセル積層体の側面との間に充填した。



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【特許請求の範囲】

【請求項１】　１層以上のセルからなるモジュールを複数積層してセル積層体を構成し該セル積層体をセル積層方向に締め付けて構成した燃料電池のスタック構造であって、モジュール間を接着剤により接着した燃料電池のスタック構造。

【請求項２】　前記セルは同一面内に複数のサブセルを有している請求項１記載の燃料電池のスタック構造。

【請求項３】　前記セル積層体の側面にプレートを設け、前記接着剤の少なくとも一部を該プレートと前記セル積層体の側面との間に充填した請求項１記載の燃料電池のスタック構造。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、燃料電池のスタック構造に関し、とくに固体高分子電解質型燃料電池のスタック構造に関する。

【０００２】

【従来の技術】固体高分子電解質型燃料電池の単セルは、膜－電極アッセンブリ（ＭＥＡ：Membrane-Electrode Assembly）とセパレータとからなる。膜－電極アッセンブリ（ＭＥＡ：Membrane-Electrode Assembly）は、イオン交換膜からなる電解質膜とこの電解質膜の一面に配置された触媒層および拡散層からなる電極（アノード、燃料極）および電解質膜の他面に配置された触媒層および拡散層からなる電極（カソード、空気極）とからなる。セパレータは、アノード、カソードに燃料ガス（アノードガス、水素）および酸化ガス（カソードガス、酸素、通常は空気）を供給するための流体通路を形成する。燃料電池スタックは、１層以上のセルを積層してモジュールとし、モジュールを複数積層してセル積層体を構成し、セル積層体のセル積層方向両端に、ターミナル、インシュレータ、エンドプレートを配置し、セル積層体をセル積層方向に締め付け、セル積層体の外側でセル積層方向に延びる締結部材（たとえば、テンションプレート）にて固定したものからなる。固体高分子電解質型燃料電池では、アノード側で、水素が水素イオンと電子にされ、水素イオンは電解質膜中をカソード側に移動し、カソード側で酸素と水素イオンおよび電子（隣りのＭＥＡのアノードで生成した電子がセパレータを通してくる、セル積層体の一端のセルの電子が外部回路を通してセル積層体の他端のセルにくる）から水が生成される。

アノード側：$H_2 \rightarrow 2H^+ + 2e^-$

カソード側：$2H^+ + 2e^- + (1/2)O_2 \rightarrow H_2O$

ジュール熱およびカソードでの水生成反応で出る熱を冷却するために、セパレータ間には、各セル毎にあるいは複数個のセル毎に、冷却媒体（通常は冷却水）が流れる流路が形成されており、燃料電池を冷却している。上記の電気化学反応が正常に行われるためには、セパレータと電極との電気的接触が保持され、かつ、燃料ガス、酸化ガス、冷媒等の流体が、セパレータと電極間からあるいはセパレータ間から漏れないように、セル積層体（モジュール積層体でもある）はセル積層方向に締め付けられ、該締め付けが保持されなければならない。従来のセル積層体の締め付け、締め付け保持は、たとえば特開２０００－２０８１６３に開示されているように、セルを積層したスタックをセル積層方向に締め付けボルト・ナットで固定し、かつ、締め付け荷重が安定するようにばねを介してセル積層体を押すことにより行われている。

【０００３】

【発明が解決しようとする課題】しかし、従来方法のセル積層体の締め付け、締め付け保持では、ばねを含む加圧部品が必要であり、必要な電気的接触およびシールを得るためには、加圧部品が大型で重量大になる。また、セル積層体のセル積層方向の長さを短縮するために、セルの同一面内に複数（たとえば、ｎ）のサブセルを配しそれを積層方向に接続して構成したサブスタックを直列または並列に接続しようとすると、セル面積が複数（たとえば、ｎ）倍になり、それに比例して加圧部品が大型で重量大になり、加圧部品が大型化した分セル積層体の短縮分が相殺されて、セル積層体の長さ短縮効果が期待した程得られなくなる。本発明の目的は、加圧部品を無くすか、または加圧部品を設けても加圧部品を小型化できる、燃料電池のスタック構造を提供することにある。

【０００４】

【課題を解決するための手段】上記目的を達成する本発明はつぎの通りである。

（１）　１層以上のセルからなるモジュールを複数積層してセル積層体を構成し該セル積層体をセル積層方向に締め付けて構成した燃料電池のスタック構造であって、モジュール間を接着剤により接着した燃料電池のスタック構造。

（２）　前記セルは同一面内に複数のサブセルを有している（１）記載の燃料電池のスタック構造。

（３）　前記セル積層体の側面にプレートを設け、前記接着剤の少なくとも一部を該プレートと前記セル積層体の側面との間に充填した（１）記載の燃料電池のスタック構造。

【０００５】上記（１）の燃料電池のスタック構造では、モジュール間を接着剤により接着したので、加圧力を接着剤で保持でき、従来必要であった加圧部品が不要になるか、設けても小型化でき、その結果、燃料電池スタックを小型化（セル積層方向に短縮）できるとともに、重量低減、コスト低減をはかることができる。上記（２）の燃料電池のスタック構造では、セルが同一面内に複数のサブセルを有しても、セル面積は増大するものの、加圧部品が無いか小型化できるため加圧部品の大型化を招くことがなく、同一面内に複数のサブセルを設けることによるスタックの短縮化の利点をそのまま維持で

きる。上記（３）の燃料電池のスタック構造では、セル積層体の側面にプレートを設け、接着剤の少なくとも一部をプレートとセル積層体の側面との間に充填したので、加圧力を接着剤とプレートで保持でき、従来必要であった加圧部品が不要になるか、設けても小型化でき、その結果、燃料電池スタックを小型化（セル積層方向に短縮）できるとともに、重量低減、コスト低減をはかることができる。また、プレートにより、車両衝突時などにおいてもセル積層体を保護できる。

【０００６】

【発明の実施の形態】以下に、本発明の燃料電池のスタック構造を図１～図８（図１～図４は本発明を、図５～図８は比較例）を参照して、説明する。本発明のスタック構造が適用される燃料電池１０は固体高分子電解質型燃料電池である。本発明の燃料電池１０は、たとえば燃料電池自動車に搭載される。ただし、自動車以外に用いられてもよい。

【０００７】固体高分子電解質型燃料電池１０の単セル２９は、図１～図４に示すように、膜－電極アッセンブリ（ＭＥＡ：Membrane-Electrode Assembly ）とセパレータ１８とからなる。ＭＥＡは、イオン交換膜からなる電解質膜１１と、この電解質膜１１の一面に配置された触媒層１２および拡散層１３からなる電極１４（アノード、燃料極）、および電解質膜１１の他面に配置された触媒層１５および拡散層１６からなる電極１７（カソード、空気極）とからなる。

【０００８】セパレータ１８は、アノード１４に燃料ガス（水素）を供給するための流体通路２７および電極１７に酸化ガス（酸素、通常は空気）を供給するための流体通路２８および燃料電池冷却用の冷媒（冷却水）が流れる冷媒流路２６を形成する。冷媒流路２６はセル毎に、または複数のセル毎に、設けられる。たとえば、２つのセル毎に１つの冷媒流路２６が設けられる。セパレータ１８は、燃料ガスと酸化ガス、燃料ガスと冷却水、酸化ガスと冷却水、の何れかを互いに分離するとともに、隣り合うセルのアノードからカソードに電子が流れる電気の通路を形成している。セパレータ１８は、カーボン板に冷媒流路２６やガス流路２７、２８を形成したもの、または、流路２６、２７、２８を形成する凹凸のある金属板を複数枚重ね合わせたもの、または、導電製樹脂板（たとえば、導電材粒子を混入して導電性をもたせた樹脂板）に冷媒流路２６やガス流路２７、２８を形成したもの、の何れかからなる。図示例はセパレータ１８がカーボン板からなる場合を示している。

【０００９】燃料電池のスタック２３は、１層以上（図２では２層）のセル２９からなるモジュール１９（複数セルから１モジュールを構成する場合は、セル間は電解質膜１１を挟んだセパレータ１８間で接着剤３０ｂで固定されている）を複数積層してセル積層体を構成し、該セル積層体をセル積層方向に締め付けるとともに、モジュール１９間を接着剤３０ａにより接着して構成される。セル間の接着剤３０ｂはセパレータ間に電極を保持し、絶縁性を必要とする。モジュール間の接着剤３０ａはモジュール間をシールし、導電性のあるものを用いてもよいが、絶縁性のあるものと塗りわけるのが大変なので、絶縁性のあるものを用いてもよい。接着剤３０は、セル積層体の側面に塗布形成されてもよい。セル積層体の側面に塗布形成した接着剤３０ｃは、セル間の絶縁性を確保するために、絶縁性のあるものを用いる。セル積層体のセル積層方向締め付けは、セパレータと電極との電気的接触を得るためと、燃料ガス、酸化ガス、冷媒のシールのために必要である。セル積層体のセル積層方向両端には、ターミナル２０、インシュレータ２１、また、必要に応じてエンドプレート２２が配置される。

【００１０】接着材３０（３０ａ、３０ｂ）は、樹脂を主成分とし、乾燥、固化する材料からなる。接着材３０は、セル積層体締め付け時にセパレータ間またはセパレータと金属プレート間の接触を防止することが必要な部分に用いられる場合はセラミックビード（セラミック小球）を含んでいてもよい。接着材３０ｂは、セルを積層してセル積層体とする時にモジュール対向面に塗布され、接着材３０ｃは、セル積層後、セル積層体側面に塗布される。その後、接着材３０ｂ、３０ｃは乾燥され、固化されて、セル締め付け荷重保持部材となる。セル積層方向のセル２９間、モジュール１９間の締め付け荷重の保持は、図２に示すように、接着剤３０（３０ａ、３０ｂ、３０ｃ）により行われる。また、図４に示すように、必要に応じて、セル積層体の外側に、プレート３４を配し、プレート３４側面とセル積層体との間を接着剤３０（３０ｃ）で充填し、乾燥固化させて、プレート３４と接着剤３０（３０ａ、３０ｂ、３０ｃ）との両方でモジュール間の締め付け荷重を保持してもよい。プレート３４を設ける場合、プレート３４の両端をエンドプレート２２にセル積層方向と直交方向に延びるボルト２５で固定してもよい。

【００１１】セル２９は、図３に示すように、同一面内に互いに電気的に絶縁された複数（図では４個の場合を示すが個数は４に限るものではない）のサブセル３１を有していてもよい。同一面内において、サブセル３１は電解質膜１１は共有するが、電極１４、１７はサブセル同士独立で互いに電気的に絶縁されている。セル２９を積層した場合、サブセル３１はセル積層方向に直列に接続しサブスタックを構成する。サブスタック同士は、セル積層体のセル積層方向端部で、互いに、電気的に直列または並列に接続される。セル２９が複数のサブセル３１をもつことにより、セル積層体のセル積層方向長さは短縮される。

【００１２】図５～図８は比較例（本発明に含まず）を示す。図５、図６は本発明のサブセル３１と同じセル面積をもつセルを積層し、セル積層体のセル積層方向一端

にブレッシャプレート３２を配し、ブレッシャプレート３２とエンドプレート２２との間に皿ばね３３を配して、セル積層体に締結荷重を付与した例を示す。

【００１３】図７、図８のものは、同じく比較例であるが、同一面内に４つのサブセル（各サブセル面積は図６のセル面積と同じ）を有するセルを積層してセル積層体長さを図５のものに比べて１／４にしたものである。セル面積が図６のものの４倍になったために、セル積層方向に付与する荷重は図５、図６のものの４倍になる。そのため、ブレッシャプレート３２、エンドプレート２２、皿ばね３３がセル積層方向にも、それと直交方向にも、大型化する。その結果、セル積層体長さが図５のものの１／４になっても、セル積層体と加圧部品を含むスタック長さは、加圧部品が大型化することにより、図５のものの１／４にはならず、それより大きくなり、サブセル化したことによるセル積層体短縮効果が薄れる。

【００１４】つぎに、本発明の燃料電池のスタック構造の作用を説明する。本発明の燃料電池のスタック構造では、モジュール１９間を接着剤により接着したので、加圧力を接着剤で保持でき、従来必要であった加圧部品（図５～図８の皿ばね３３、ブレッシャプレート３２等）が図１に示すように不要になるか、たとえ皿ばね等の加圧部品を設けてもセル積層方向に小型化できる。その結果、燃料電池スタックを小型化（セル積層方向に短縮）できるとともに、重量低減、コスト低減をはかることができる。

【００１５】また、図３の燃料電池のスタック構造のように、セル２９が同一面内に複数のサブセル３１を有しても、セル２９面積は増大するものの、加圧部品が無いか小型化できるため加圧部品の大型化を招くことがなく、同一面内に複数のサブセルを設けることによるスタック長の短縮化の利点をそのまま維持できる。さらに詳しくは、本発明の図３の燃料電池のスタック構造において、各サブセル３１の面積が図６のもののセル面積と等しい場合、図３のサブセル３１をもつセル２９のセル積層体のセル積層方向の長さは、図５のセル積層体のセル積層方向長さの、サブセル個数分の１になる。図３の例では、サブセル個数が４であるから、図３のセル２９を積層したセル積層体の長さは、図５の通常セル積層体の長さの１／４になる。そして、本発明では、接着剤３０でセル積層方向の締め付け荷重が保持されるから、図７のようにセル積層体の一端に皿ばねを設ける必要がないか、または設けても図７のものの皿ばね３３、ブレッシャプレート３２を含む加圧部品に比べてセル積層方向に小型化される。

【００１６】また、図４の燃料電池のスタック構造では、セル積層体の側面にプレート３４を設け、接着剤３０の少なくとも一部３０ｃをプレート３４とセル積層体の側面との間に充填したので、加圧力を接着剤３０ｃとプレート３４で保持でき、従来必要であった加圧部品が不要になるか、設けても小型化できる。その結果、燃料電池スタックを小型化（セル積層方向に短縮）できるとともに、重量低減、コスト低減をはかることができる。また、プレート３４は、従来の両端エンドプレート間に延びてスタック締結荷重を保持するテンションプレート２４（図５、図７）に類似する構造材であるが、本発明のプレート３４は、プレート３４と接着剤３０との両方でスタック締め付け荷重を受けるため、テンションプレート２４だけで締結力を受けていた従来に比べて、プレート３４の厚みはテンションプレート２４の厚みより薄くできる。したがって、プレート３４を設ける場合であっても、テンションプレート２４を設けていた従来に比べて、重量軽減がはかられている。また、プレート３４を車両搭載時にスタック２３の車両前後方向前側に配することにより、プレート３４により、車両衝突時などにおいてもセル積層体を保護できる。したがって、プレート３４は、締結力を受ける役割を果たすとともに、車両衝突時のスタック保護効果をも果たしている。

【００１７】

【発明の効果】請求項１の燃料電池のスタック構造によれば、モジュール間を接着剤により接着したので、加圧力を接着剤で保持でき、従来必要であった加圧部品が不要になるか、設けても小型化でき、その結果、燃料電池スタックを小型化（セル積層方向に短縮）できるとともに、重量低減、コスト低減をはかることができる。請求項２の燃料電池のスタック構造によれば、セルが同一面内に複数のサブセルを有しても、セル面積は増大するものの、加圧部品が無いか小型化できるため加圧部品の大型化を招くことがなく、同一面内に複数のサブセルを設けることによるスタックの短縮化の利点をそのまま維持できる。請求項３の燃料電池のスタック構造によれば、セル積層体の側面にプレートを設け、接着剤の少なくとも一部をプレートとセル積層体の側面との間に充填したので、加圧力を接着剤とプレートで保持でき、従来必要であった加圧部品が不要になるか、設けても小型化でき、その結果、燃料電池スタックを小型化（セル積層方向に短縮）できるとともに、重量低減、コスト低減をはかることができる。また、プレートにより、車両衝突時などにおいてもセル積層体を保護できる。

【図面の簡単な説明】

【図１】本発明の燃料電池のスタック構造が適用された燃料電池の側面図である。

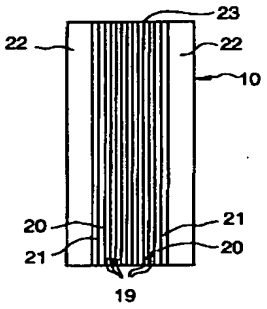
【図２】図１の燃料電池の一部分の拡大断面図である。

【図３】本発明の燃料電池のスタック構造において、セルが同一面内に複数のサブセルを有する場合の、セルの正面図である。

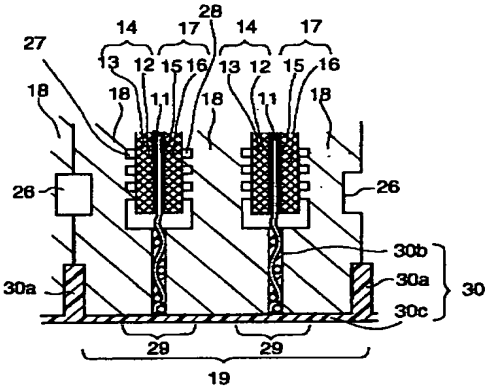
【図４】本発明の燃料電池のスタック構造において、セル積層体側面にプレートを設けて、プレートとセル積層体側面間にも樹脂を充填した場合の、燃料電池の一部分の拡大断面図である。

【図５】比較例１（セルが複数のサブセルをもたない）の燃料電池の側面図である。
【図６】図５の燃料電池のセルの正面図である。
【図７】比較例２（セルが複数のサブセルをもつ）の燃料電池の側面図である。
【図８】図７の燃料電池のセルの正面図である。
【符号の説明】
１０　（固体高分子電解質型）燃料電池
１１　電解質膜
１２　触媒層
１３　拡散層
１４　電極（アノード、燃料極）
１５　触媒層
１６　拡散層
１７　電極（カソード、空気極）
１８　セパレータ
１９　モジュール
２０　ターミナル
＊２１　インシュレータ
２２　エンドプレート
２３　スタック
２４　テンションプレート
２５　ボルト
２６　冷媒流路
２７　燃料ガス流路
２８　酸化ガス流路
２９　セル
３０　接着剤
３０ａ　モジュール間接着剤
３０ｂ　セル間接着剤
３０ｃ　プレートとセル積層体側面間接着剤
３１　サブセル
３２　プレッシャプレート
３３　皿ばね
３４　プレート

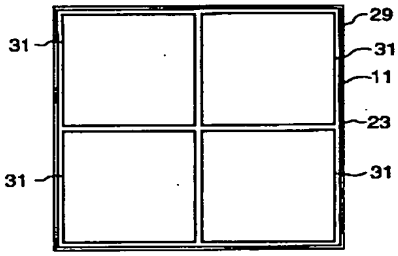
【図１】



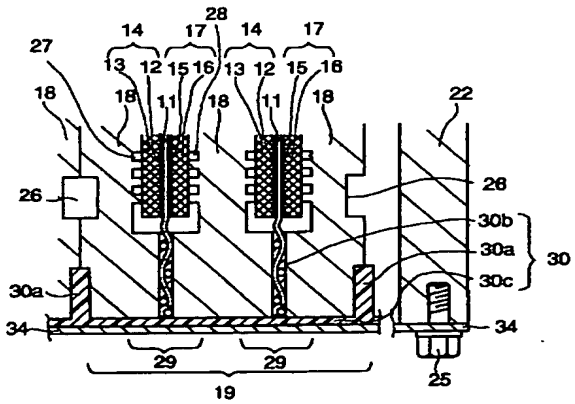
【図２】



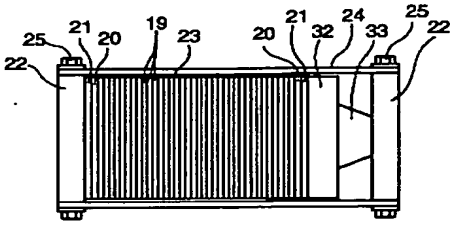
【図３】



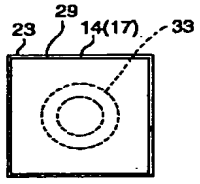
【図４】



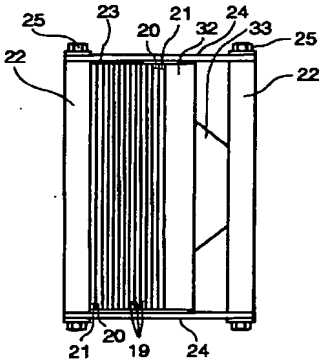
【図５】



【図６】



【図７】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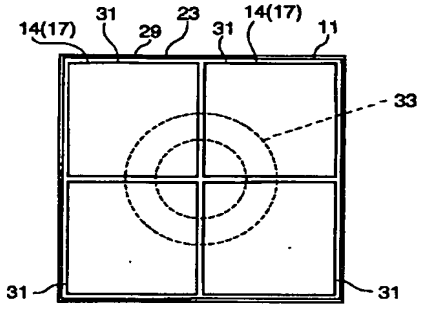
【図８】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